

Chapter 11
Biological Diversity and
Development Assistance

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Biological Diversity and Development Assistance

HIGHLIGHTS

- The United States has a stake in maintaining biological diversity in developing countries. Many of these nations are in regions where biological systems are highly diverse, pressures that degrade diversity are most pronounced, and the ability to forestall a reduction in diversity is least well developed.
- With recent amendments to the Foreign Assistance Act and earmarking of funds, the United States has defined maintaining biological diversity as an important objective in U.S. development assistance. It is unclear, however, whether the Agency for International Development (the principle U.S. development assistance agency) can effectively promote conservation of biological diversity.
- Development assistance can help improve the capacity of developing countries to maintain diversity by 1) building public support; 2) establishing an information base; 3) building institutional support; 4) promoting planning and management; 5) increasing technical capacity; and 6) increasing the direct economic benefits from sustainable use of biological resources.
- Multilateral development banks strongly influence the nature of resource development in developing countries. Recent congressional pressures to encourage these banks to place greater emphasis on environmental implications of their activities, including threats to biological diversity, have met with some success. Continued monitoring of progress in this area is necessary to enhance progress made to date.

INTRODUCTION

Concern about the loss of biological diversity is acute for developing countries for several reasons. First, the level of diversity is greater in developing countries particularly in tropical locations, than it is in industrial countries. Second, biological diversity is less well-documented in developing countries. Third, conversions of natural ecosystems to human-modified landscapes are more pronounced and likely to accelerate in developing countries due to the combined pressures of population growth and poverty. Finally, developing countries characteristically lack both the technical and financial resources to address these issues.

The United States has a stake in maintaining biological diversity, particularly in developing countries. The rationale for assisting developing countries rests on the following:

1. recognition of the substantial benefits of a diversity of plants, animals, and microorganisms;
2. evidence that degradation of ecosystems can undermine U.S. support of economic development efforts; and
3. esthetic and ethical motivations to avoid irreversible loss of unique life forms (see box 11-A).

Box 11-A.—U.S. Stake in Maintaining Biological Diversity in Developing Countries

Political Interests

- The United States has strong commitments to world peace, economic and social stability, and maintenance of the Earth's basic life-support systems—commitments that require concern about the integrity and long-term productivity of the world's natural resource base.
- U.S. public institutions and private firms conduct activities that directly and indirectly affect biological resources of other nations and, therefore, are in positions to influence the attitudes and actions of host governments and local citizens on biological diversity maintenance.
- Political stability can be compromised as a result of a breakdown of ecological systems. Civil unrest in countries such as Haiti and El Salvador has been attributed, in part, to degradation of natural resources.

Economic Interests

- The non-oil-exporting developing nations purchase one-third of all U.S. exports. Adverse domestic resource conditions seriously affect the ability of these countries to buy U.S. goods and services.
- Many of the natural reservoirs of crop genetic diversity are located in developing countries. Without a diverse base for crop breeding, the development of high-yielding tree and crop varieties characteristic of the Green Revolution cannot be sustained.
- Over the years, the United States has invested billions of dollars in international development assistance programs that could be undercut by loss of biological diversity associated with resource degradation.
- The United States has lent billions of dollars to developing countries. Continued declines in natural resources will reduce the ability of these nations to pay their debts.

Humanitarian Interests

- The United States is committed to meeting basic needs and supporting developing coun-

tries' economic and social development, which in turn is linked inextricably to the quality and integrity of the world's natural resource base.

- The United States increasingly is being requested by governments and international development organizations to provide technical assistance and financial support for conservation-related activities in developing countries.

Environmental Interests

- The United States shares with South and Central America and the Caribbean area hundreds of species of migratory animals—birds, insects, marine turtles, mammals—whose survival depends on maintaining suitable habitats.
- The United States is committed to help preserve the world's flora, fauna, and vulnerable ecosystems by virtue of domestic legislation and national policies, and by being party to a large number of international conventions and agreements. Principal among these measures are the Endangered Species Act of 1973, the Convention on International Trade in Endangered Species of Wild Flora and Fauna, and the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere.

Educational and Scientific Interests

- Advances in medicine depend heavily on research animals found in developing countries. The United States accounted for more than half the estimated 30,000 primates traded internationally in 1982 for use in medical research.
- Rich arrays of living systems demonstrate the many ways organisms can cope with variable and often unfavorable physical and biotic environments. Hence, areas such as tropical forests provide unparalleled opportunities to understand complex processes of evolutionary interaction.

SOURCE: Adapted from U.S. Interagency Task Force, *The World's Tropical Forests: A Policy, Strategy, and Program for the United States* (Washington, DC: U.S. Department of State, 1980).

INTEGRATION OF ECONOMIC DEVELOPMENT AND BIOLOGICAL DIVERSITY MAINTENANCE

Interests and activities of development agencies and conservation organizations have merged in recent years, in light of the changing perspectives of these two groups. Historically, conservation organizations and development agencies planned their efforts independently in developing countries (64). Conservation groups focused almost exclusively on natural areas, promoting protection from human exploitation and preservation of particular wild species and their habitats. In contrast, development organizations focused on raising the standard of living in both rural and urban areas and concentrated on the major agricultural species.

Increasingly, development assistance agencies and developing country governments are establishing policies that recognize the importance of environmental factors in development strategies. These policies stem from a growing awareness in development planning of the costs of ignoring environmental factors. The greater reliance of developing-country economies on their natural resource base—soils, fisheries, and forests—underlies this growing appreciation for sustainability in development initiatives.

Planning began to include environmental considerations in cost-benefit and similar analyses during the 1970s. The emphasis was on mitigating side effects, such as pollution and salinization. By the late 1970s, development agencies began to include components to sustain the resource base that affected a project. Watershed protection above irrigation systems received funding, for instance, Development assistance in the early 1980s supported projects to deal directly with the problems associated with natural resource degradation, such as fuelwood shortages in arid regions.

Although maintaining biological diversity has not become an objective of assistance projects, these steps led toward development that generally caused less resource degradation and thus generally benefited diversity maintenance. In the 1983 Amendment to the Foreign Assis-

tance Act (described in the next section), Congress directed the Agency for International Development (AID) to support projects that have maintenance of biological diversity as a specific objective, such as establishing protected areas and controlling poaching.

Conservation organizations, in turn, realized that their traditional emphasis on establishing parks and protected areas would be insufficient to protect biological diversity and began to broaden their approach. These groups have increasingly realized that failure to account for the needs of rural people jeopardizes the long-term success of conservation projects.

A clear manifestation of conservationists' efforts to reorient their activities is the development of the World Conservation Strategy (WCS). This document links conservation with development and provides policy guidelines for determining development priorities that secure sustainable use of resources (20). The WCS has three principal objectives: 1) the maintenance of essential ecological processes, 2) the preservation of genetic diversity, and 3) the sustainable use of species and ecosystems. The document is used to increase dialog on the interests and approaches of the development and conservation communities. It has been only partially successful, however. The WCS has been effective in narrowing the gap of conservation and development interests in policy documents, but on a practical basis this gap remains.

Part of the problem with linking development and conservation lies in the failure to identify common criteria and benefits. Conservation activities generally justify projects by biological and esthetic criteria. For example, conservation organizations would draw attention to the Tuatara (*Sphenodon punctatus*) of New Zealand because it is the last remaining species of an entire order of reptiles (32). Unique or spectacular habitats are also given special attention. Conservation organizations also focus on spectacular species of birds or mammals, largely in response to the esthetic interests of contributors,

Development initiatives, on the other hand, are directed by economic criteria. Internal rates of return and similar economic analyses, for example, are important steps in justifying particular projects. This emphasis can be detrimental for biological diversity because many values associated with maintaining diversity are difficult to measure (see ch. 2) and thus are undervalued in development project decisions (28). The standard economic approach may be unable to account for the loss of biological diversity, where time horizons are long, benefits are diffuse, and losses are irreversible (37). The problem is particularly acute for weakened economies where overexploiting renewable resources to meet immediate needs often undermines the chances for long-term sustainability of resources.

Lack of institutional overlap also presents problems in defining common ground among development and conservation interests. Responsibilities for natural resources are generally split among agencies (e. g., agriculture, forestry, and wildlife). Despite efforts by developing countries to establish offices responsible for broader environmental issues, the agencies are frequently unable to add conservation components to development activities, let alone to compete with other agencies for financial or administrative support.

Another management problem that can hinder efforts to protect a particular habitat or species is the imbalance between the means devoted to conservation enforcement and the market value of the protected resource. The salaries of officials assigned to enforce conservation measures can be extremely low compared to the worth of the resources they are guarding. Perhaps a more difficult dilemma is trying to dissuade local populations from exploiting or degrading protected areas when subsistence requirements and lack of alternatives compel them to do so.

This problem raises a central question in defining the role of development assistance in maintaining biological diversity. Should development assistance support diversity maintenance if such initiatives have adverse impacts

on the people it is intended to help? Current legislation (discussed later in this chapter) stresses the beneficial aspects of maintaining diversity in overall development. But some diversity maintenance projects can conflict with local development interests. For instance, conflict can arise by denying access to resources on protected lands. Wildlife conservation efforts in proximity to agricultural lands may also threaten crops, domestic livestock, and even humans (9).

In examining the issue of possible conflicts between development and diversity maintenance, it is perhaps useful to define two approaches to maintaining diversity. First is the symptomatic approach. This is the approach typically undertaken by environmental groups and is often directed at protecting a particular species and its habitat. Because of the focused nature of this approach, needed interventions, usually involving strict protective measures, are often easy to define. However, such a program can be costly and difficult to implement, especially if initiated only after threats reach a critical point. Problematic from a development perspective is the case where strict protective measures impinge on the interests of local populations.

Alternatively, there is a curative approach to threats to diversity. This approach attempts to address the root causes of the threats to diversity. It generally involves a much broader array of initiatives and is less focused on diversity per se. It emphasizes the human element of the conservation equation.

The greatest threats to diversity in developing countries stems less from the impacts of development than from a lack of development. Addressing the root causes of threats to diversity will therefore need to emphasize the availability of opportunities for individuals in developing countries to enhance their quality of life. This is the approach generally taken by development assistance agencies in their efforts to elevate standards of living by creating employment opportunities and increasing access to education, health care, and family planning.

Both approaches will be necessary in meeting the challenges of diversity maintenance. Within the context of U.S. interests to promote diversity maintenance through the channels of development assistance, it is important to stress areas of overlap between these two approaches. That is, emphasis should be placed on promoting the type of projects that, on the one hand, promote opportunities for local populations and, on the other hand, maintain the diversity within biological systems.

This approach is based on the proposition that the best way to maintain diversity within a development initiative is to use that diversity. Examples abound of efforts to capitalize on diversity maintenance in areas ranging from tourism to biological resource development (9). This utilitarian approach should be approached with caution, however. It is important to ensure that initiatives will be environmentally, economically, and institutionally sustainable over the long term. Identifying possibilities for multiple uses of an area or biological resource should be stressed. Further, it is important to ensure that the benefits of such interventions actually accrue to the people affected,

A consensus exists that long-term conservation must have a base of support at the national level and account for the interests and par-

ticipation of local populations. It seems reasonable, therefore, to stress these criteria in development assistance projects supporting biological diversity. These criteria provide consistency in U.S. interests in conservation and development and promote projects most likely to succeed. Cases will arise in which the particular focus of protection inevitably conflicts with local demands. Resolving such conflicts is the responsibility of local or national governments, although foreign assistance can be useful, especially in providing resources to facilitate or compensate for a particular intervention. Whether such support should be considered under particular development assistance or through other channels is not clear,

The greatest opportunities, however, lie in taking a more forward-looking and anticipatory approach by helping countries define strategies and policies to preempt such conflicts. Support for planning, management, and inventory of diversity, promoting in-country expertise, and constituencies to support diversity maintenance initiatives help reduce the incidence of conflict between development and diversity maintenance. In the final analysis, the success of U.S. support for maintaining diversity in developing countries will depend on success in promoting the capacity in the developing countries themselves.

U.S. RESPONSE

After nearly a decade of legislative and administrative concern about the role of U.S. foreign assistance in environmental protection (see box 11-B), the case for U.S. action to conserve diversity in developing countries was recognized in Section 119 of the Foreign Assistance Act (FAA), added by Congress as part of the International Environment Protection Act of 1983 (Public Law 180-64). This amendment includes the following:

- authorizes the President to furnish assistance to countries in protecting and maintaining wildlife habitats and in developing sound wildlife management and plant conservation programs (Sec. 119(b));

- directs the Administrator of AID, in consultation with the heads of other appropriate government agencies, to develop a U.S. strategy including specific policies and programs to protect and conserve biological diversity in developing countries (Sec. 119(c)); and
- requires the President to report annually to Congress on the implementation of Section 119 (Sec. 119(d)).

Section 119 signals Congress' belief that U.S. development assistance should specifically initiate projects traditionally undertaken by conservation organizations. In effect, AID has been directed to deal not only with the foundations

Box 11-B.—Amendments to Foreign Assistance Act Concerning International Environmental Protection

Congressional concern international environmental protection has increased markedly over the last decade. U.S. foreign assistance programs began incorporating environmental concerns in the late 1970s when a series of amendments to the Foreign Assistance Act defined the Agency for International Development's (AID) mandate in the area of environment and natural resources. These amendments gave specific emphasis to promoting efforts to halt tropical deforestation, a major threat to conserving biological diversity.

- **1977:** Amended Section 102 to add environment and natural resources to areas AID should address.
- **1977:** Added new Section 118 on "Environment and Natural Resources," authorizing AID to fortify "the capacity of less developed countries to protect and manage their environment and natural resources" and to "maintain and where possible restore the land, vegetation, water, wildlife, and other resources upon which depend economic growth and well-being, especially that of the poor."
- **1978:** Amended Section 118, requiring AID to carry out country studies in the developing world to identify natural resource problems and institutional mechanisms to solve them.
- **1978/79:** Amended Section 103 to emphasize forestry assistance, acknowledging that deforestation, with its attendant species loss, constituted an impediment to meeting basic human needs in developing countries.
- **1981:** Amended Section 118, making AID's environmental review regulations part of the act, and added a subsection (d), expressing that "Congress is particularly concerned about the continuing and accelerating alteration, destruction, and loss of tropical forests in developing countries." Instructs the President to take these concerns into account in formulating policies and programs relating to bilateral and multilateral assistance and to private sector activities in the developing world.
- **1988:** Added Section 119, directing AID in consultation with other Federal agencies to develop a U.S. strategy on conserving biological diversity in developing countries.
- **1986:** Redesignated Section 115 as Section 117 with the new Section 118 addressing tropical forest issues.
Amended Section 119, which among other things earmarked money for biological diversity projects.

SOURCE: Adapted from B. Rich and S. Schwartzman, "The Role of Development Assistance in Maintaining Biological Diversity *In-Situ* in Developing Countries," OTA commissioned paper, 1985.

of the threats but also with some of the consequences.

The *U.S. Strategy on the Conservation of Biological Diversity: An Interagency Task Force Report to Congress* was delivered to Congress in February 1985, in response to Section 119. This report was followed by an annual report, *Progress in Conserving Biological Diversity in Developing Countries FY1985*, which outlines implementation of Section 119 a year later.

The strategy has been criticized for lack of commitment to action, even though it contains 67 recommendations. Its most concrete aspect is allocation of responsibilities among agencies,

but this is done without any indication of funding mechanisms. Some critics have questioned whether the strategy advances a cohesive plan and whether U.S. Government agencies are significantly increasing their allocation of resources to address this issue (54,58). Severe budget constraints undoubtedly limit the degree to which new programs can be put forward. It is therefore critical for agencies to establish clear priorities and to indicate which actions need to be taken and how much they will cost.

AID drafted an Action Plan on Conserving Biological Diversity in Developing Countries, to apply the general recommendations to specific agency programs and policies (51). It pro-

poses specific actions based on strategy recommendations and assigns them a priority of near-term (within the next two fiscal years) or long-term (requiring additional or redirected resources). However, it is clear that initiatives are determined by funding restrictions rather than by critical needs.

Another difficulty with the draft action plan is reflected in responses from various AID missions. Reviews of the draft express skepticism that specific initiatives can be implemented at the mission level, based solely on the broad, generalized directions it contains. Recent congressional earmarking of the AID budget to support diversity projects further emphasizes

the need to develop a more refined strategy for identifying priority projects.

Despite the criticisms of AID's draft action plan, it represents the agency's effort to identify its responsibilities for about half of the 67 recommendations contained in the strategy. Other Interagency Task Force members have yet to identify how their resources and expertise could be applied to the strategy. Development of action plans by other Federal agencies may be a useful way to identify strengths and opportunities within each agency, to identify areas for cooperation, and to provide a way to examine agency commitments more effectively.

IMPLEMENTATION OF U.S. INITIATIVES: THE AGENCY FOR INTERNATIONAL DEVELOPMENT

Overall, AID has developed an extensive set of guidelines and procedures for programs to incorporate concerns for the environment. To this extent, it deserves high marks compared with other development assistance agencies, both bilateral and multilateral. Less evident, however, are indications that these procedures are being consistently implemented. Critics question AID's incorporation of environmental assessments of project development at a stage when modifications can be easily made (67),

Several factors limit AID's implementation of biological diversity initiatives in developing countries, including a belief by the agency that it is adequately addressing biological diversity, declining budgets and staff to initiate projects, and an inadequate number of trained personnel to address conservation issues.

Defining the maintenance of biological diversity as a priority is viewed with some trepidation at the highest levels of AID (27). The issue is seen as one among many priorities (e. g., women in development, child welfare, and so on) identified in the Foreign Assistance Act. Although such mandates have been partially effective, their numbers, the frequency of changes, and the lack of priority among them

may hamper efficient management of agency resources (16,53,60).

AID has been forced to allocate declining resources in response to various congressional mandates. It is unlikely that programs to safeguard diversity can compete successfully for an increased share of the AID budget. Reviews of AID's implementation of environmental projects provide reason to be skeptical (16,41).

Because diversity conservation is related to many factors (e. g., poverty, population pressure, pollution, and agricultural policies), AID believes its obligations are largely addressed by conventional assistance projects (41). For instance, the February 1985 task force report to Congress identified 253 projects as having a conservation component (62). Few of these, however, are the types of projects identified in Section 119. Most involve more indirect contributions, such as reducing destructive pressures on habitats.

These indirect initiatives are critical, of course. Without them, the long-term prospects for biological diversity would be dismal. Perhaps projects identified in Section 119 should be viewed as supplemental measures or as attempts to designate important conservation

areas while they can still be easily protected. One concern, however, is that Section 119, as the central piece of legislation addressing concerns for maintaining diversity in developing countries, may define biological diversity, and the initiatives to conserve it too narrowly.

Congress has expressed dissatisfaction with the level of funding AID has directed to meeting the provisions of Section 119 by earmarking \$2.5 million for diversity projects in fiscal year 1987. This amount represents the only specified funding for environmental projects contained in the FAA. That this appropriation is intended to account for diversity on three continents, however, stresses the need to allocate this funding judiciously. Also of concern is the impact of this earmarking on support for other conservation initiatives, such as those in Sections 117 and 118 of FAA that lack any specific funding provisions.

Yet simply allocating new funds for diversity projects may not be an adequate response. If projects are proposed to meet a spending target without allocations based on an established set of priorities, efforts may be inefficient or even counterproductive.

The agency's commitments to biological diversity projects and to acting on environmental concerns have been eroded by the Gramm-Rudman-Hollings Act (70). Overall, 4.3 percent of AID's 1986 budget was sequestered, but the Office of Forestry, Natural Resources, and the Environment (FNR) had its budget cut 25 percent (26). Such reductions indicate where agency priorities lie and add credence to claims that despite a commitment to environmental concerns, commitment in the form of resource allocation lags.

It should also be noted, however, that the two major funding sources (the Agricultural, Rural Development, and Nutrition account and the Selected Development Activities account) that support most environmental projects also suffered disproportionate cuts—15.5 and 20.6 percent (50). These reductions reflect congressional, not AID, appropriations.

One proposed way to increase the emphasis and visibility of environmentally related issues is to elevate FNR to a bureau (10). Because many of the funding allocation decisions are made at the bureau level, this change in status may increase the share of resources devoted to diversity projects. Such an action, on the other hand, could isolate a newly established bureau.

An alternative is to establish a separate funding source, such as a Forestry, Natural Resources, and Environment account, for various bureaus and offices as well as overseas missions to draw on. Several functional accounts (e. g., Agriculture, Rural Development, and Nutrition; and Population and Health) already exist. Establishing an additional account will likely be seen as further constraining AID's flexibility. It would, however, place resources behind congressional concerns for biological diversity and the environment and natural resources generally, as outlined in Section 119 as well as Sections 117 and 118.

Another approach would seek to incorporate biological diversity concerns into AID development activities at different levels of the agency ranging from general policy documents at the agency level to more strategic efforts at the regional bureau and missions levels. AID could prepare a policy determination (PD) document on biological diversity that would serve as a general statement that maintaining diversity is an explicit objective of the agency.

Existence of a PD could mean that consideration of diversity concerns would, where appropriate, become an integral part of sectoral programming and project design. Further, it would require that projects be reviewed and evaluated by the Bureau of Program and Policy Coordination for consistency with the objectives of the PD. Because of the increase in bureaucratic provisions this would create, the formulation of a PD on diversity would probably not be well received within AID.

The three regional bureaus (i.e., Africa, Asia and Near East, and Latin America and the Caribbean) could also prepare documents that

identify important biological diversity initiatives in their regions. The Asia and Near East Bureau, in fact, has already prepared such a document. But the lack of agency commitment and the hesitancy of the bureau to redirect scarce funds have reduced the document's utility thus far. The Africa Bureau is currently completing a natural resources management plan that includes an assessment of regional priorities for biological diversity maintenance.

The development of such reports for each regional bureau is considered an effective way to identify priorities for projects, especially given the earmarking of funds. A network of specialists and information sources already exists to help identify priority areas. For example, committees of the International Union for the Conservation of Nature and Natural Resources (IUCN), and especially its Conservation Monitoring Center in Cambridge, England, are major sources of such information.

AID country-level environmental profiles can also identify priorities for diversity projects. The agency has completed 50 preliminary Phase I profiles and 17 in-depth Phase II profiles (see table 11-1), AID has also supported "state of the environment" reports in five countries, which are similar to environmental profiles but generally prepared within the country by a local group (18).

The most important focus of biological diversity strategies is at the mission level, where projects are implemented. Congress has already mandated that Country Development Strategy

Statements and other country-level documents prepared by AID address diversity concerns. Most missions, however, lack the expertise or adequate access to expertise needed to address this provision of Section 119 as amended.

AID has recently developed a concept paper to explore the desirability of establishing a diversity project within AID's Bureau of Science and Technology. Benefits of such a project include centralizing access to funding and perhaps expertise on biological diversity. The preliminary nature of the concept paper, however, makes more critical assessment premature.

In response to AID funding cuts, staff cuts, and a move to cut management units, conservation groups have proposed several ways to loosen up money for biological diversity projects (2,6). Of particular interest are calls for greater use of Public Law 480 funds for conservation projects. This option has both precedence (52) and the potential to increase activities in this area. It would enable a relatively small dollar amount to be supplemented with larger amounts of foreign currency. The use of excess foreign currencies by the U.S. Fish and Wildlife Service (discussed later in this chapter) provides further opportunities.

Matching grants provided to conservation organizations offers another cost-effective way to promote projects. AID matching grants to World Wildlife Fund-U.S. for its Wildlands and Human Needs Projects and to The Nature Conservancy International for its network of Conservation Data Centers are good examples of such public/private cost-sharing initiatives.

Another constraint to implementing Section 119 is the lack of adequately trained personnel in environmental sciences within AID (6,10,67). Although AID designates an environmental officer at each mission, the person may have little background in environmentally related issues. The duties of an environmental officer are included with numerous other duties; few AID personnel are full-time environmental officers.

The agency could recruit personnel with environmental science backgrounds and provide

Table 11-1.—Country Environmental Profiles Undertaken or Supported by the Agency for International Development

Areas with profiles	Phase I profile	Phase II profile	State of the environment report
Asia/Near East/North			
Africa	15	1	2
Latin America/Caribbean	14	14	2
Sub-Saharan Africa	21	2	1
Total	50	17	5

SOURCE: International Institute for Environment and Development, Environmental Planning and Management Project, "Country Environmental Profiles, Natural Resource Assessments and Other Reports on the State of the Environment" Washington, DC, May 1986

further training to officers to address this problem. Developing-country professionals could also be enlisted as environmental officers within the missions. This action would be consistent with recent agency emphasis on reducing the U.S. presence in AID missions for economic as well as security reasons.

Taking advantage of expertise that exists within other U.S. agencies (e.g., National Park Service, Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, Smithsonian Institution, and Peace Corps) could also significantly enhance the effectiveness of development assistance. The agency already has a Resource Services Support Agreement with the U.S. Department of Agriculture to provide forestry expertise and services. Such mechanisms can be used to establish a formal agreement with agencies such as the Department of the Interior to provide AID missions with access to conservation expertise. In addition, other agencies such as the Peace Corps are already supporting some projects in the field

that focus on biological diversity. Increased collaboration between AID and the Peace Corps can be mutually beneficial.

Section 119 states the following:

... whenever feasible, the objectives of this section shall be accomplished through projects managed by appropriate private and voluntary organizations, or international, regional, or national nongovernmental organizations [INGOs] that are active in the region or country where the project is located.

A number of NGOs are already working with AID in developing capacity to maintain diversity in developing countries. These include important initiatives in the areas of conservation data centers, of supporting development of national conservation strategies, and of implementing field projects. AID is also using a private NGO to maintain a listing of environmental management experts. Such partnership could continue to be encouraged by Congress through oversight hearings, for instance.

THE ROLE OF MULTILATERAL DEVELOPMENT BANKS

Multilateral development banks (MDBs) are the largest providers of development assistance and have considerable influence on development policy and financing. In this capacity, they are uniquely situated to influence environmental aspects of development (40). In 1983, the World Bank, the Inter-American Development Bank, the African Development Bank, and the Asian Development Bank in 1983 loaned at least \$20 billion to fund projects in developing countries—nearly three times the amount committed by the U.S. Agency for International Development, the largest bilateral agency. Funds loaned by MDBs are supplemented by larger amounts from governments of recipient countries, and many projects receive cofinancing from other development agencies and private banks. For every dollar loaned by the World Bank, for example, more than 2 additional dollars are raised from other sources (41).

Many countries modify their development policies in response to MDB suggestions and

pressures. An important element is the developing-country sector work of the MDBs—policy documents produced as background material to help identify priorities in lending.

MDB's influence on policy can be the single most important influence in many countries on the development model adopted (41). Because agricultural, rural development, and energy policies can have profound effects on habitats, diversity in developing countries can be significantly affected by MDB policies.

The most immediate effect of MDBs on maintaining biological diversity may be support for creating protected areas. The World Bank has been the leader among development banks in this area—the bank has financed the protection of 59,000 square kilometers in 17 countries. It has funded entire conservation projects—for instance, a wildlife reserve and tourism project in Kenya. More often, it has included conservation components in larger projects—for in-

stance, a protected area in conjunction with an irrigation project in Indonesia. In this case, the designated area protects tropical forest and wildlife while providing key watershed management services. Even conservation components that represent a small fraction of a project's total cost can play a substantial role in preserving diversity.

The performance of MDBs in preserving diversity depends on their more general environmental policies and the degree to which these policies are implemented. In this regard, the banks have issued statements emphasizing the need for sound environmental management projects.

The World Bank, the Inter-American Development Bank, the Asian Development Bank, and six other multilateral in 1980 signed a "Declaration of Environmental Policies and Procedures Relating to Economic Development." As a result, these organizations formed the Committee of International Development Institutions on the Environment (CIDIE), under the auspices of the United Nations Environment Programme (UNEP). CIDIE has met five times since 1980 to exchange information on progress and plans of MDBs for improving their environmental performance. Under the terms of agreement, the agencies will perform systematic environmental analyses of activities, fund programs and projects designed to solve environmental problems, manage resources sustainably, and provide support for improving environmental policymaking institutions and their capacity to implement environmental controls in developing countries.

A study prepared by the International Institute for Environment and Development for the fourth CIDIE meeting found, however, that the commitment of MDBs to sound environmental management in development projects was not effectively translated into action. The study came to the following conclusions:

The fact that we found so little evidence of the application of existing guidelines suggests that either they have been tried and found useless, or that agencies have not made sufficient resources and incentives available to sustain

their use. We suggest that some agencies never put some guidelines into operation because their function is to improve public relations. . . . In many cases, staff do not use guidelines because agencies do not require their use, nor provide appropriate training and resources, nor establish any institutional penalties for failing to use them (16).

A number of congressional hearings have brought to light evidence of serious ecological problems resulting from projects supported by MDBs (54,55,56,57). Through testimony presented at these hearings, several categories of projects were identified that may directly contribute to large-scale environmental destruction. Categories cited as problematic included large-scale cattle ranching (especially in the tropics), hydroelectric power projects and irrigation systems, and resettlement projects (41). Evidence of low economic returns and high environmental costs associated with a number of these projects suggest that greater scrutiny of environmental impacts should be applied before MDBs provide financing.

Following these hearings, the House Subcommittee on International Development Institutions and Finance issued a series of recommendations to the U.S. Treasury Department, in effect proposing a U.S. environmental policy for MDBs (41). These recommendations were largely supported by the Treasury Department, the lead Federal agency for U.S. participation in these organizations. Included were calls for increased environmental staffing and mandatory procedures for project review, and for the U.S. executive directors of the MDBs to try to modify or oppose projects that would erode the natural resource base. Recommendations also emphasized the needs for institution-building and training in conservation, improved management of protected areas, involvement of indigenous peoples in development planning, and withdrawal of support from projects that cause extensive damage to habitats in species-rich areas.

Because U.S. influence in MDBs has traditionally been strong, a concerted effort from the U.S. executive directors no doubt could improve MDB environmental performance and

make significant contributions to maintaining biological diversity. Emergence of a Wildlands Management Policy at the World Bank may, in part, reflect congressional and public attention on the subject. The recently approved policy sets guidelines for the management of natural areas in bank projects. These include avoiding conversion of wildlands of special concern, giving preference to using already converted lands, compensating for the loss of wildlands by setting aside similar areas, and preserving relevant wildland areas.

To maintain momentum, however, continued congressional oversight and input from U.S.

executive directors is likely to be needed, such as in efforts to enlist greater environmental expertise within the banks. Language contained in the fiscal year 1986 appropriations bill clearly reflects congressional interest on this subject (21).

Consideration could also be given to promoting the approach to diversity maintenance embodied in the recent World Bank policy. To this end, U.S. representatives could be encouraged to establish a similar approach within CIDIE.

PROMOTION OF CAPACITY AND INITIATIVES IN DEVELOPING COUNTRIES

A large number of initiatives at the international level have addressed various aspects of diversity maintenance in developing countries (see ch. 10). These range from international meetings to treaties and conventions such as the Convention on International Trade in Endangered Species of Wild Flora and Fauna. Such initiatives can be important in raising awareness of the issue and of national responsibilities. They can effectively set standards, monitor progress, serve as promotional work, and establish legal norms (8). An international perspective also enables interested parties to define global priorities. However, translating these initiatives into concrete activities requires that they be implemented and supported at the national and local levels, underlining the importance of developing national capacities and constituencies to address loss of diversity.

The responsibility for maintaining biological diversity within a country's borders ultimately falls on national governments. Yet it can be argued that national governments have responsibilities to the international community. Avoiding loss of genetic resources that may meet the needs of future generations and maintaining diversity because it represents the biological heritage of the planet are commonly heard arguments in this regard,

These arguments may be insufficient or unconvincing for many developing countries, especially when national resources would have to be devoted to maintaining diversity, yet the benefits would accrue outside their borders. In other cases, a country may acknowledge its national interests in maintaining diversity but lack the resources—both financial and technical—to stem the loss,

Six priority areas where U.S. bilateral assistance could promote abilities and initiatives in developing countries have been identified: building public support, establishing an information base, building institutional support, promoting planning and management, increasing technical capacity, and increasing economic benefits derived from wild species. Although described separately, these areas are mutually reinforcing.

Building Public Support

Creating a favorable climate of public opinion is critical to the success of conservation programs. Developing countries commonly lack an organized base of citizen support; in the few cases where support has existed, in Ecuador for example, it has been a key element in efforts to launch programs.

A study of poor farmers in Costa Rica found that:

... farmers could not comprehend the concept of "untouchable" forest reserves, The values of outdoor recreation, wildlife, and biological diversity may be seen by wealthy policy makers but they are generally alien to poor farmers struggling for survival (45).

Consequently, efforts to protect habitats may depend on demonstrating to rural populations that they will benefit from such activities and on soliciting their support in project design and implementation (36).

Benefits to those in rural areas can be in the form of actual financial compensation, as in the Amboseli game reserve in Kenya. Here, Masai pastoralists participated in designing a conservation program, and they now benefit financially from the arrangement through tourist revenues and through employment opportunities (63). Alternatively, local support can be solicited by convincing people of the importance of maintaining diversity. In Malaysia, for example, public support was marshaled to protect the Batu caves from quarrying by pointing out that the durian, a highly valued fruit crop, depends on cave-nesting bats for pollination (36).

The opening of the Kuna Indian Udirbi Tropical Forest Reserve, a 5,000-acre park on Panama's Atlantic coast, resulted from integrating local peoples' desire to protect a forested area of cultural and religious importance with the establishment of income-generating facilities for visiting scientists and naturalists. The project is unusual because it was initiated by the Kuna themselves and had unanimous support. A number of organizations (including the Centro Agronomic Tropical de Investigacion y Ensenanza, the Smithsonian Tropical Research Institute, AID, the Inter-American Foundation, and the World wildlife Fund-U. S.) have provided technical and financial support, although both the benefits and management responsibilities are being directed toward the Kuna (41,69),

Emphasis on environmental education is another strategy for building public support

(36). A major constraint at all school levels is the shortage of appropriate teaching materials in local languages (67). Furthermore, most textbooks use examples drawn from temperate zone ecosystems, which can be difficult for students in the tropics to understand. Development of teaching materials could help remedy this.

In Costa Rica, the World Wildlife Fund's conservation and education program, working with the Ministry of Education and educators and conservationists from local universities, developed educational material in Spanish for elementary school ecology courses. The material was tested by 70 teachers in 11 schools, reaching 2,000 students in 1982. The success of the program led to its adoption by the Ministry of Education and to the distribution of materials to all public elementary schools in the country in 1984. World Wildlife Fund expanded the program into Colombia and Honduras in 1984 and to Brazil and Guatemala in 1985 (4).

Mobilizing public support through mass information campaigns has also been successful in developing countries. In Malaysia, for example, numerous private voluntary and non-governmental organizations, such as the



Photo credit G Lieberman

An education project in Costa Rica funded by the World Wildlife Fund allows elementary school students to study ecology with textbooks in their native language. Above, sixth graders study relationships between different plant species. The program, begun in 1982, has been expanded to Colombia, Honduras, Guatemala, and Brazil.

Malayan Nature Society, the Friends of the Earth, and the Consumers' Association of Penang, conduct information programs to develop public understanding (1),

In a number of campaigns, flagship species are identified. These are species with high esthetic appeal that are often endemic to a country, and consequently capable of generating public interest and pride in the nation's biota. For instance, the yellow-tailed woolly monkey—Peru's largest and most endangered primate—is the centerpiece of a campaign to protect its cloud forest habitat in a project begun in 1984 by the World Wildlife Fund-U.S. in conjunction with the Natural History Museum of Lima and the Peruvian Conservation Foundation (69). Although this approach has been criticized for focusing inordinate attention on large mammals at the expense of other endangered taxa, it has been effective in rallying public support around certain species, promoting public awareness and in the process protecting other endangered species through habitat preservation.

Support for indigenous private and voluntary organizations has also been identified as an important component of building public support. Bolstering such organizations can create reliable recipients and managers of conservation funding with the potential of becoming self-supporting, a national constituency for exerting pressure on decisionmakers, public awareness for biological diversity, and a grassroots capacity to respond quickly and flexibly where governments cannot or will not (13,59). Monitoring development projects for undesirable environmental impacts is another important role for these groups.

Experience has shown, however, that this approach has certain constraints (18,59,60). These include saturating particular groups with funding and distorting the natural growth of these small organizations. AID, as a large agency usually dealing with large amounts of money, may be reluctant to initiate contact with many small organizations to promote small-scale projects. These concerns can be addressed by working more closely with umbrella nongovernmental

organizations (e. g., the Environmental Liaison Centre in Nairobi) or through American groups that have local counterparts or affiliates in developing countries. Another option is to have agencies with more experience working at the grassroots level (e.g., the Peace Corps or the Inter-American Foundation) take a lead in this area.

Establishing an Information Base

Conducting an inventory and monitoring the biota are two key steps that facilitate corrective action in situations where human activity threatens diversity (5). An inventory can combine a traditional biological survey with the most modern technology such as remote sensing. It might also simply involve pulling together information on the status, distribution, and threats to major ecosystems and species to determine conservation priorities and affect land-use decisions.

Monitoring biological diversity refers to surveillance of the distribution and abundance of flora and fauna. The purpose is to detect adverse impacts on species or habitats, assess the extent to which human activities are responsible, and then promote corrective measures wherever possible (5).

Although nationally instituted programs to conduct inventories and monitor biological diversity are rare, a few examples do serve as models. The Mexican National Research Institute for Biological Resources (INIREB, from the full title in Spanish), for instance, prepares an inventory of plant and animal resources, studies threatened and endangered species, establishes reserves and protects habitats of ecological importance, develops alternative land-use strategies, and trains professionals in conservation-oriented fields. The range of activities undertaken by INIREB indicates the balanced approach of this organization.

Promoting national or regional databases to monitor biological diversity is an effective way to synthesize information and help define research and conservation priorities. A number of international organizations have developed

databases of use to governments, assistance agencies, and conservation organizations, Still, promoting in-country capacity for such activities is an important goal. First, these databases can provide a finer evacuation (i. e., of higher resolution), defining local priorities within a regional context, than is possible with information covering larger areas. Second, the process can foster in-country expertise and bolster environmental effectiveness.

A major initiative to develop country-level Conservation Data Centers (CDCS) in Latin America and the Caribbean is currently being undertaken by The Nature Conservancy International (TNCI). CDCS are modeled on the State Heritage Programs begun 15 years ago in the United States. To date, six CDCS have been established in partnership with local institutions, with plans to expand this to 35 programs by the end of the decade. In terms of bolstering national capacity, the strengths of CDC programs lie in their employment of scientists (a zoologist, a botanist, an ecologist, and a data handler); their emphasis on institutionalizing the system; and their pressure to have local collaborating agencies adopt operational funding after 3 to 5 years [13].

The CDC programs devote little attention, however, to public education components. Furthermore, although the programs assemble existing information difficult for foreign institutions (e.g., from world museums and herbaria), they do little to provide new information in a region where at least five-sixths of the organisms are unknown (38). Overall these programs are very useful in identifying areas of conservation interest. Accordingly, the U.S. Fish and Wildlife Service has contracted with TNCI to develop databases on distribution of natural plant communities and to identify areas of high endemism and diversity in Latin America (25).

In lieu of formal CDCS, which could take considerable time, resources, and effort to disseminate broadly, some developing countries could benefit from more modest systems (35). A simple computer in the office in a ministry or university could record existing studies and represent a major improvement in national capacity,

Inventorying and monitoring biological resources are also important in maintaining genetic diversity among domesticated species. The rate at which farmers are replacing traditional, genetically diverse crop varieties with more uniform, high-yielding varieties is the subject of much concern in industrial and developing countries. Considerable effort to collect and store germplasm has already been made for major crop varieties, with less done for minor crops and wild relatives.

Efforts have been made to collect data, including prototypes for national databases, on threatened breeds of livestock in developing countries (12). But, information on genotype loss is inadequate to focus initiatives, USDA could provide assistance in this area through increased support to the FAO and the International Board for Plant Genetic Resources, for example, to help develop abilities to monitor losses of livestock and crop genetic resources,

Building Institutional Support

The greatest obstacles to addressing the loss of diversity are less technical than economic and political. Consequently, building institutional capacity—in both the public and private sectors—is of paramount importance. However, institution-building through development assistance is a difficult process that requires both long-term commitment and a strong appreciation of national sovereignty.

Concern about the environment is a relatively new addition to the political agendas of developing countries—for many, it dates to the 1972 U.N. Conference on the Human Environment held in Stockholm, Sweden. At that time, much of the attention on environmental problems in developing countries was generated from outside, notably from industrial countries. Most lacked a national constituency among government agencies, scientists, environmental groups, or the general public that perceived a threat stemming from degradation of the environment {17},

A great deal has changed since then. The Stockholm Conference accentuated pollution problems and the need for industrial standard

setting—concerns most developing country governments felt were industrial country problems (23). Since then, environmental concerns have broadened to emphasize conservation of natural resources. Developing countries are on average six times more dependent on a productive resource base—soils, fisheries, and forests—which provides rationale for greater developing country concerns in this area (43).

Discussions on environmental issues are now being initiated by developing countries. The number of environmental agencies has increased since 1972 from about one dozen to 110 (43). However, most agencies have been ineffective in addressing environmental concerns. This ineffectiveness is due to the constraints discussed earlier, including a lack of personnel, training, and resources; an inability to compete with established interests; and a lack of legal authority.

Encouraging the development of institutional capacity is not easy, but U.S. development assistance agencies have the experience and the legal mandate to help in the process. Initiatives to enhance the stature, effectiveness, and resources of agencies responsible for conservation have been identified (10). These initiatives include requiring developing country officials to submit comments on environmental and natural resource aspects of U.S. development assistance projects and soliciting greater input from ministries in AID's development of country environmental profiles and natural resource assessments (10).

The process of infusing an awareness of biological resources in overall development planning was an objective in an AID-supported natural resources profile undertaken by the Thai Development Research Institute—a national policy analysis group (22). The process is important because it involves identification of needs and responsibilities of the 24 agencies in Thailand responsible for natural resources. Ultimately, the profile should be incorporated into the country's 5-year development plan.

An environmental profile of Paraguay illustrates the importance of the process, as much as the product, for infusing awareness of bio-

logical diversity throughout a country's institutions (66). This AID-supported project, carried out by the National Planning Secretariat of the Presidency, involved some two dozen Paraguayan scientists, technicians, and other specialists. The emphases on increasing reliance on national scientists and policy makers, on a broad intersectoral approach, and on support from the highest levels of government are keys to meeting the objectives of building institutions.

Promoting Planning and Management

As pressures on natural resources in developing countries increase, the need to integrate conservation and development interests will become more critical. Planning and management strategies should be included in resource development initiatives—from habitat protection onsite to germplasm storage offsite—and these initiatives should consider wild species as well as domesticates.

Developing a national strategy to conserve biological diversity should account for the mixed objectives for maintaining the array of species, and the mixed status of these groups (29). A biological continuum of ecosystems, species, populations, and varieties fills various needs, and various management programs and techniques are appropriate. Consequently, management objectives and technologies and the links between them should be taken into account, as well as the most urgent problems to address (29).

One activity that addresses this problem is the development of national conservation strategies (NCSS), which are general policy statements on the role of conservation in development planning (19). AID began support of an NCS for Nepal in fiscal year 1985 through the International Union for the Conservation of Nature and Natural Resources (IUCN), and it is continuing to assist in the preparation or implementation of similar strategies for Sri Lanka, the Philippines, and Zimbabwe (52). Although the general nature of these documents may limit their usefulness in implementing specific proj-

ects, they can be important vehicles for presenting the case for maintaining biological diversity (evidenced by the NCS for Zambia) (44).

The lack of management plans for specific protected areas has been identified as a major problem in almost all developing countries. Without them, most areas suffer from inappropriate development, sporadic and inconsistent management, and lack of clearly defined management objectives, ways to develop such plans have been proposed and are being applied to six major protected areas: Amboseli, Kenya; Simen Mountains, Ethiopia; Sapo, Liberia; Khao, Thailand; Sinharaja, Sri Lanka; and Am-boro, Bolivia (44). A country may also analyze its existing parks and protected areas to develop plans for an orderly allocation of natural areas (44). Although few examples of such plans exist, methods for doing this analysis have also been developed. Systems are currently in place in Brazil, Indonesia, and Dominica (44).

In situ genebanks have received some attention as a way to conserve gene pools of wild economic plants (see ch. 5). The strategy has particular relevance for developing countries, where most of the ancestral stock of current economic species occurs. General guidelines for managing such units have been developed (34). Sri Lanka (for wild medicinal plants), India (for citrus and sugarcane), and Mexico (for teosinte) have either prepared or are developing plans for *in situ* genebanks. Efforts are under way to expand this strategy to tropical South America (35).

Maintaining diversity through traditional parks and protected areas is becoming difficult for some nations for economic and political reasons, and it is likely to become less common in the future. Setting aside land for a single use can often be an economic impossibility. Some nations, particularly small countries and islands, do not have the large, undisturbed tracts of land. The trend is toward integrating reserves as part of overall development plans, rather than adding them later as areas separate from development.

Few approaches, however, have considered the role of human activities in ecological proc-

esses affecting protected areas (see ch. 5 for further discussion). Strategies for conserving diversity are starting to consider this. Conservationists are beginning to promote strategies that surround protected areas with zones of compatible land use (such as the UNESCO biosphere reserve program) and to encourage the use of regional plans to manage resources (such as the Organization of American States' integrated regional development planning).

The potential of botanic gardens and zoological gardens as a management tool in developing countries is unclear, but it could be enhanced through links with other institutions and with existing international networks (see ch. 10) (24). These institutions occupy a unique position because of their links between onsite and offsite efforts. One example proving successful is the Rio de Janeiro Primate Center that is involved with the captive breeding and reintroduction of the golden lion tamarin (69).

Concern over loss of agriculturally important resources suggests a need to devote more attention to better management of germplasm collection, storage, and use in developing countries, preliminary studies have been conducted on the feasibility of enhancing national programs in animal germplasm maintenance. A number of obstacles have been identified: technical constraints, problems of isolation of breeds, disease control, funding sources for long-term facilities, and political concerns, such as where to locate genebanks and who owns them (15).

As mentioned earlier, several regional institutions have already identified threatened breeds of livestock and maintained data on them. This work is also a starting point for enhancing regional capacities to develop offsite storage facilities. These institutions, which could benefit from financial or technical support, include the Inter-African Bureau for Animal Resources in Nairobi, Kenya; International Livestock Centre for Africa in Addis Ababa, Ethiopia; Asociacion Latinoamericana de Production Animal in Maracay, Venezuela; and the Society for the Advancement of Breeding Research in Asia and Oceania in Kuala Lumpur, Malaysia (39).

The number of crop genetic resource programs in developing countries has increased dramatically over the last decade. In part, this increase reflects an awareness of the importance of collecting, maintaining, and evaluating plant germplasm as a prerequisite to meeting future food requirements. Much of the change is also credited to the International Board for Plant Genetic Resources (IBPGR), which has played a catalytic role in encouraging and supporting national genebanks.

Ten years ago, only a handful of genebank collections existed, primarily in industrial countries. As of 1985, 72 countries—45 of them in the developing world—had long- or medium-term germplasm storage facilities in operation or under construction (33). IBPGR currently has agreements with 31 countries (25 of them developing ones) to serve as international base collections for long-term storage of plant germplasm. As the network of long-term collections approaches its goal of 50, covering 40 major crops before the end of the century, greater attention will be focused on bolstering medium-term collections, 100 of which have already been identified. Facilitating medium-term collections is particularly important for those developing countries where the costs and technical requirements make the establishment of long-term facilities impractical.

The operation and effectiveness of various national plant germplasm programs is uneven. Particularly disconcerting has been the failure of some national programs to respond to an IBPGR Seed Storage Advisory Committee recommendation to rectify inadequacies and improve scientific standards at existing facilities (65).

Increasing Technical Capacity

The availability of trained personnel is another constraint to conservation. The problem has been studied intensively in the Latin American region and in Africa since the mid-1970s (11,31,46,47,48,68). However, neither governments nor international or bilateral development assistance agencies have come forward with sufficient funding to meet the needs outlined in these studies.

For a total of 50 developing countries, there are only six technical colleges established to meet regional training needs for protected area managers: at Bariloche in Argentina, the Centro Agronomic Tropical de Investigación y Enseñanza in Costa Rica, the Ecole de Fauna in Cameroon, the College of African Wildlife Management in Tanzania, the Wildlife Institute of India in Dehra Dun, and the School of Conservation Management in Indonesia at Bogor (44). Most of these colleges need external support, and all could be encouraged to augment biological diversity concerns in their curricula.

The efforts of several U.S. Federal agencies to provide training, technical assistance, and distribution of technical information hold potential for increasing technical capacity in developing countries. Those involved include the U.S. Fish and Wildlife Service (FWS), National Park Service (NPS), U.S. Forest Service, the Smithsonian Institution, and National Oceanic and Atmospheric Administration. Activities have been outlined in several documents (e.g., ref. 61). For example, congressional legislation to implement the Western Hemisphere Convention directs FWS to devote attention to personnel development in Latin America. This development has been accomplished through several initiatives, with special emphasis on training wildlife biologists, where possible, through in-country workshops. The Foreign Service Currency Program allows FWS to provide training in Egypt, India, and Pakistan. Authorized in Section 8(a) of the Endangered Species Act, this program allows excess foreign currencies to be used toward conserving threatened or endangered species in those countries (25).

AID and other government agencies have developed cooperative arrangements with several U.S. universities, other scientific institutions (e.g., botanic and zoological institutions), and private conservation organizations. These arrangements provide avenues to direct assistance funding toward increasing technical capacity and training of country personnel.

The University of Michigan, through funding from Federal agencies (e. g., NPS), has international seminars that provide training in areas such as park management, forest man-

agement, and coastal-marine management. FWS has undertaken several projects with World Wildlife Fund-U.S. to promote expertise in species and habitat conservation. The University of Florida, in conjunction with a program offered by the National Zoo's Conservation and Research Center in Front Royal, VA, provides hands-on research and training to developing-country students (4).

U.S. development assistance could promote technical training through national and regional germplasm conservation and storage programs. Although most of the support for training currently comes from international organizations, principally the IBPGR and the Food and Agriculture Organization of the United Nations (FAO), USDA could enhance its activities in this area through the National Plant Germplasm System and the Forest Service. The thrust of these U.S. agency efforts, however, may be better directed at identifying areas where assistance could be channeled through existing training programs.

Specific training on conserving animal resources has been organized through FAO and UNEP. A 2-week course (taught in English) is offered through the University of Veterinary Science in Budapest, Hungary. The primary goal of this course is to provide developing-country participants with an overview of the present state of theory and practice (3). Although this type of training usefully draws attention to the importance of animal genetic resources, conservation strategies will depend on a commitment by national governments to avoid haphazard crossing of indigenous breeds and to monitor the most endangered ones (15).

Training and management are also critical for operating plant germplasm storage facilities. A 1-year graduate program in conservation and use of plant resources at the University of Birmingham in England has provided training to more than 100 developing-country scientists (14). Some graduates now direct genetic resources programs in their home countries, IBPGR has also established a training program (taught in French) at Gembloux, Belgium, and a training program to be taught in Spanish is under consideration (14). Some 500 developing-



Photo credit "International Board for Plant Genetic Resources

Genetic resources conservation requires a cadre of qualified personnel. The University of Birmingham in England has an international postgraduate program in genetic conservation.

country scientists have benefited from IBPGR-supported courses on plant genetic resource management and from internship programs at international agricultural research centers. In addition, IBPGR has helped incorporate relevant courses in universities in several developing countries (65). Despite these advances, training in genetic resource conservation and use still needs increased attention.

Increasing Direct Economic Benefits Of Wild Species

One of the most forceful arguments for the need to maintain biological diversity has been the potential that wild species hold to improve the 'quality of human life. The examples of

perennial corn and rosy periwinkle (an anti-leukemia drug) are commonly cited in the literature on this subject. For the most part, however, this rationale has been expounded by scientific, conservation, and political groups in industrial countries, where motivations as well as technologies to exploit genetic resources are comparatively well-developed.

The point has been less forcefully argued or acted on in developing countries. The reason may be because these countries have been unable to capitalize on their biological resources; the products and profits from them—for many reasons, including differences in levels of technology, research facilities, and interest—accrue

elsewhere. Given that the greatest diversity of potentially important organisms is located in developing countries (e.g., centers of diversity of crop species and moist tropical forests as sources of medicinal products), enhancing the incentives for developing countries is critically important.

Various mechanisms exist to promote identification and development of biological resources in developing countries. Supporting research by developing-country scientists, such as through the AID Program in Science and Technology Cooperation (49), offers opportunities not only to promote development of indigenous biological resources but also to cultivate scientific expertise and supporting



Photo credit: United Nations/photo by S Stokes

Crocodile farm in Papua New Guinea has potential to provide direct economic benefits and encourages protection of biological resources.



Photo credit: UN/UNDP photo 154002, S Maines

To reduce dependence on tea, rubber, and coconut exports, Sri Lanka is promoting the cultivation of minor export crops such as citronella.

institutions as well. Ethnobotanical surveys and research represent another promising avenue for encouraging greater recognition of the importance and opportunities of maintaining biological diversity. Wildlife-based tourism and other wildlife utilization enterprises offer further possibilities. However, these should be approached with some caution to ensure that benefits actually accrue to the country and account for the interests of local populations (9).

Loss of agricultural genetic resources in developing countries is a pronounced concern. Addressing it will depend on enhancing capacity in national agricultural programs and increasing awareness of the potential of germplasm to contribute to development needs. Continued U.S. support for International Agricultural Research Centers, especially the International Board for Plant Genetic Resources, serves an important role in this regard. Bilateral programs through the U.S. Department of Agriculture, such as the one that currently exists with Mexico, could also be promoted, Accounting for the unique contributions of traditional agricultural systems will also need special attention. Ongoing research provides strong evidence on the importance and potential of these high diversity, low input systems in addressing the particular needs and limitations of most developing-country agriculturalists (42). Greater support for research in investigating

and improving indigenous agricultural systems is seen as a high priority for development assistance. Increasing attention is also being addressed at incorporating traditional agroecosystems within biosphere reserves programs (30).

The prospects and promises of biotechnology have prompted a few developing countries to place a premium on developing their capacities in this field. Although biotechnology's contributions to biological diversity maintenance is mixed, the incentives it may provide developing countries to protect and develop their genetic resources argues for supporting developing-country expertise. Access to technical procedures, however, is generally restricted to countries with well-developed capabilities. A large number of developing countries could apply these technologies to exploit genetic resources if access to information, training, and technology were improved. Microbiological Research Centers, otherwise known as MIRCENS (see ch. 10), place a strong emphasis on training developing-country scientists. The recently created International Center for Genetic Engineering and Biotechnology, established by the United Nations Industrial Development Organization, also has as its main function the dissemination of these technologies to developing countries.

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